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A Novel Optical Coherence Tomography System for Lipid-rich Plaque Detection

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Background: Vulnerable coronary plaque is characterized by large lipid core. Although commercially-available OCT systems use near-infrared light at 1,300 nm wavelength, lipid shows characteristic absorption at 1,700 nm. Therefore, we developed a novel, short wavelength (1,700 nm) infra-red, spectroscopic, spectral-domain optical coherence tomography (SWIR-OCT). The aim of the present study is to evaluate the accuracy of SWIR-OCT for identification of lipid tissue within coronary plaques.

Methods: Twenty-three coronary arteries from 8 cadavers were imaged at physiological pressure with 2.7F SWIR-OCT catheter. When a blood-free image was observed, the SWIR-OCT imaging core was withdrawn at a rate of 20 mm/sec using automatic pullback device. SWIR-OCT images were acquired at 94 frames/s and digitally archived. SWIR-OCT generated grayscale cross-sectional images and color tissue maps of entire plaque by using lipid analysis algorithm. After SWIR-OCT imaging, the arteries were pressure-fixed, sliced by cryostat and stained with Oil Red O, and then corresponding histology was collected in matched images. Regions of interest, selected from histology, were 75 lipidic and 64 fibrotic/calcified regions.

Results: SWIR-OCT showed high sensitivity (84%) and specificity (92%) for identifying lipid tissue within coronary plaques. The positive predictive value and negative predictive value were 98% and 48%, respectively.

Conclusions: SWIR-OCT accurately identified lipid tissue in coronary autopsy specimens. This new technique may hold promise for identifying patho-histological feature of coronary plaques at risk for rupture.

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Temporal course of neointimal maturity after implantation of biodegradable polymer sirolimus-eluting stents as assessed by optical coherence tomography gray-scale signal intensity at 3, 6 and 9 months

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Background: We previously reported that in patients undergoing follow-up after stenting optical coherence tomography (OCT) gray-scale signal intensity (GSI) analysis can differentiate between stent coverage with mature (smooth muscle cell-rich) versus immature tissue (hypocellular fibrous cap at multiple adjacent OCT frames).

Methods: We studied neointimal maturity as assessed by OCT-derived GSI analysis of contiguous cross-sections at 1 mm longitudinal intervals within the stented segment. For each cross-section the neointimal region of interest (ROI) above each covered strut was manually delineated and 256-level GSI was measured for every pixel within the ROI. Calibration was done with brightest spot GSI analysis using guide-wire at 3 and 6 months and stent strut at 9 months. Cut-off values for mature vs. immature tissue for each scale were derived from published data.

Results: OCT raw data was available for 8, 24 and 27 lesions at 3 months, 6 months and 9 months respectively. In patients undergoing follow-up at 3 months, 1602 ROIs were analyzed and median GSI scores were 90.7 [95% CI 72.9 — 134.7]; 28.2% of ROIs were categorized as mature. At 6 months, 5315 ROIs were analyzed and median GSI scores were 105.2 [62.0 — 148.4]; 38.2% of ROIs were categorized as mature. At 9 months, 3501 ROIs were analyzed and median GSI scores were 106.4 [63.4-149.5]; 58.8% of ROIs were categorized as mature.

Conclusions: In patients undergoing OCT follow-up after stenting GSI-derived scores of neointimal maturity show progressive change over time. While only a minority of tissue areas overlying stent struts were characterized as mature at 3 and 6 months, at 9 months after stent implantation the majority of covered struts could be classified as mature. Future studies should examine the clinical relevance of differences in tissue maturity over time.

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Morphological Characteristics Of Coronary Artery Spasm Sites In Vasospastic Angina: An Optical Coherence Tomography Study

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Background: Plaque characteristics at coronary artery spasm sites have not been systematically investigated. The aim of this study is to define the morphological features of coronary artery spasm sites using optical coherence tomography (OCT). 673XR and Dragon Fly catheter, Lightlab Imaging/St. Jude Medical, Westford, Massachusetts, USA) in patients with vasospastic angina (VSA).

Methods: Sixty-nine consecutive patients (80 spasm sites) with VSA manifested with acute coronary spasm or subsequent coronary angiography were included in this study. The characteristics of the spasm sites were defined as plaque disruption, plaque erosion (definite, probable, possible) or unclassified by diagnostic criteria of OCT.

Results: Two spasm sites were detected at 3 sites (4%). Spontaneous spasm was seen more frequently in acute myocardial infarction (AMI) and out-of-hospital cardiac arrest (OHCA) patients compared to non-AMI/OHCA patients (50.0% vs. 19.3%, p=0.025).

Conclusions: Our results show that OCT defined plaque erosion with thrombus is a common finding in patients with VSA. This finding suggests the potential benefit and treatment role of antiplatelet therapy in VSA.